REMARKS

Claims 1, 2, 4, 9-11, 15-23 and 25-27 are in this application and are presented for consideration. By this Amendment, Applicant has amended claims 1, 2, 18, 19 and 21. Claims 3, 4, 9 and 14 have been canceled. Applicant has also added new dependent claims 25-27.

Claims 1-4, 9-11 and 14-23 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Brewer et al. (U.S. 6,322,600) further in view of Wenski et al. (U.S. 6,530,826) and Matsuo et al. (JP 2003-200,347).

The present invention relates to a method for polishing a wafer. Applicant has discovered that conventional techniques of wafer polishing result in linear defects on the surface of the polished wafer. The present invention advantageously solves this problem by providing a method for polishing a wafer such that linear defects are not generated on the wafer. Applicant has found that supplying a polishing agent containing an alkaline solution containing an organic base or a salt thereof and silica having essentially spherical particles advantageously reduces linear defects. The silica has particles in which each particle is essentially in the shape of a sphere and has an average particle diameter of 5 to 10 nm. The organic base or salt is tetramethyl ammonium hydroxide. The tetramethyl ammonium hydroxide is used in a range from greater than 10 wt % to less than or equal to 20 wt %. Tetramethyl ammonium hydroxide advantageously improves dispersibility, prevents aggregration of the silica and suppresses generation of linear defects. The particle diameter of the silica particles is also significant in the present invention because such conditions advantageously reduce the linear defects that are

generated on the surface of the wafer. The pH of the alkaline solution is controlled in a pH value range from 10 to 13. Sodium carbonate is used for the pH adjustment of the alkaline solution during polishing. The pH value range and the use of sodium carbonate is critical in the present invention because these conditions advantageously lead to an increase of the polishing rate as well as stabilizes the polishing rate. The use of sodium carbonate advantageously provides for easy adjustment of the pH level while being easy to handle throughout the polishing process. The prior art as a whole fail to disclose such features or advantages.

Brewer et al. discloses a planarization composition for chemical mechanical planarization of dielectric layers for semiconductor manufacture. The composition comprises spherical silica particles having an average diameter from 30 nm to 400 nm. Ninety percent (90%) of the particles is within 20% of the average particle diameter. The composition includes a liquid carrier comprising 9% alcohol and an amine hydroxide in the amount of 0.2 to 9% by weight. In a preferred embodiment, the ammonium hydroxide levels are in the range of 0.2 weight % to 4 weight %. The pH of the composition is in the range of 9 to 11.5 and the remainder of the solution is water. The composition has low amounts of metal ions. The composition is used for thinning, polishing and planarizing interlayer dielectric thin films, shallow trench isolation structures and isolation of gate structures.

Brewer et al. fails to teach and fails to suggest the combination of a polishing agent with tetramethyl ammonium hydroxide in a range from greater than 10 wt % to less than or equal to 20 wt %. At most, Brewer et al. discloses a composition having a liquid carrier containing 9% alcohol and an amine hydroxide in which the pH of the composition is 9 to 11.5. However,

Brewer et al. does not disclose the specific weight percentage range of tetramethyl ammonium hydroxide as claimed. In contrast to Brewer et al., the polishing agent of the present invention has a concentration of tetramethyl ammonium hydroxide in a range from greater than 10 wt % to less than or equal to 20 wt %. This advantageously leads to an increase of the polishing rate and to an increase of the stability of polishing rate. This advantageously reduces linear defects on the wafer. Compared with the present invention, Brewer et al. only discloses using acids such as acetic acid, nitric acid, citric acid, hydrochloric acid, carboxylic acid, acetylsalicylic acid and sulfuric acid to adjust the pH level. However, Brewer et al. fails to make any mention of a polishing agent having a specific tetramethyl ammonium hydroxide concentration as claimed. As such, the prior art as a whole takes a different approach and fails to suggest the features of the claimed combination.

Wenski et al. and Matsuo et al. fail to teach or suggest the combination of a polishing agent having tetramethyl ammonium hydroxide with a concentration in the range of greater than 10 wt % to equal to or less than 20 wt %. At most, Wenski et al. discloses a cloth that contains a polishing abrasive comprising 1 to 10% weight of SiO_2 in ultrapure water, which is adjusted to a pH in the range from 9 to 12 by adding alkali, such as Na_2CO_3, K_2CO_3, NaOH, KOH, NH_4OH and tetramethylammonium hydroxide. However, Wenski et al. does not disclose a polishing agent having tetramethyl ammonium hydroxide with a concentration in the range of greater than 10 wt % to equal to or less than 20 wt % as claimed. Wenski et al. only discloses adding alkali, such as Na_2CO_3, K_2CO_3, NaOH, KOH, NH_4OH and tetramethylammonium hydroxide in proportions from 0.01 to 10% by weight. Matsuo et al. merely discloses a process

for recycling slurry that has been used in chemical mechanical polishing, but fails to disclose any specific concentration range of tetramethyl ammonium hydroxide used in the slurry. Compared with Wenski et al. and Matsuo et al., the polishing agent of the present invention includes tetramethyl ammonium hydroxide having a concentration in the range of greater than 10 wt % to less than or equal to 20 wt %. This advantageously provides a polishing agent that substantially reduces the chances of generating linear defects on a wafer when the polishing agent is applied to the wafer. This also significantly improves dispersibility and prevents aggregation of the silica. Wenski et al. and Matsuo et al. fail to provide such advantages since the references as a whole are void of any teaching or suggestion of a polishing agent having a tetramethyl ammonium hyrdoxide concentration in the range as claimed. Accordingly, the references as a whole fail to direct the person of ordinary skill in the art towards the features of the claimed combination. Accordingly, Applicant respectfully requests that the Examiner favorably consider claims 1 and 2 as now presented and all claims that respectively depend thereon.

Matsuo et al. fails to teach or suggest the combination of a starting slurry mixture that is mixed with excess polishing agent and existing polishing agent in a holding means to form a polishing agent mixture as recited in claim 18. At most, Matsuo et al. discloses that slurry is applied to chemical mechanical polishing equipment and the used slurry is carried to a storage tank 9 via a used slurry exhaust pipe 8. According to Matsuo et al., the used slurry is then stored in a recycle tank 12 and sent to an enriching section 15 and the pH is adjusted and the slurry is then sent back to the chemical mechanical polishing equipment. This is a very different

approach from the present invention. In contrast to Matsuo et al., the excess polishing agent recovered from the polishing process is sent to a holding means where the excess polishing agent mixes with existing polishing agent in the holding means as well as with slurry mixture delivered from a slurry holding tank to form a polishing agent mixture. According to the present invention, the pH of the polishing agent mixture is then adjusted in the holding means. This advantageously ensures that the polishing agent mixture has the proper pH before the mixture is applied to the wafer. This significantly reduces the likelihood of linear defects being generated on the wafer. Matsuo et al. fails to disclose such linear defect reducing advantages since Matsuo et al. does not disclose that the slurry mixture is mixed with existing slurry and a new slurry mixture in a holding means as claimed. As such, the prior art as a whole takes a different approach and fails to teach or suggest each feature of the claimed combination. Accordingly, Applicant respectfully requests that the Examiner favorably consider claim 18 as now presented and all claims that depend thereon.

Applicant has added new dependent claims 25-27 to further clarify the features of the invention. Applicant respectfully requests that the Examiner favorably consider new dependent claims 25-27 as presented.

Favorable consideration on the merits.

Respectfully submitted
for Applicant,

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